Moses Lake TMDL Groundwater Study

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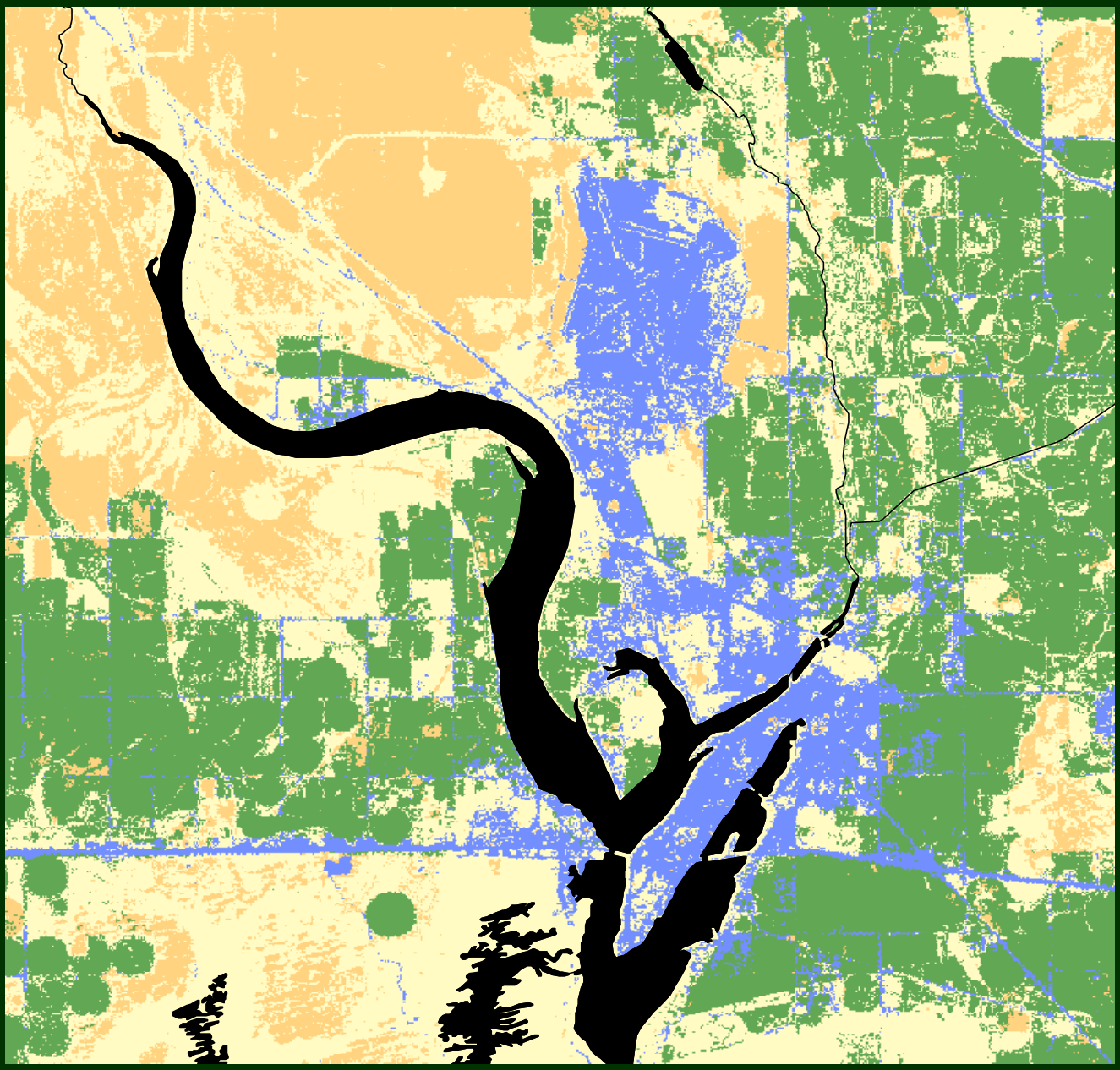
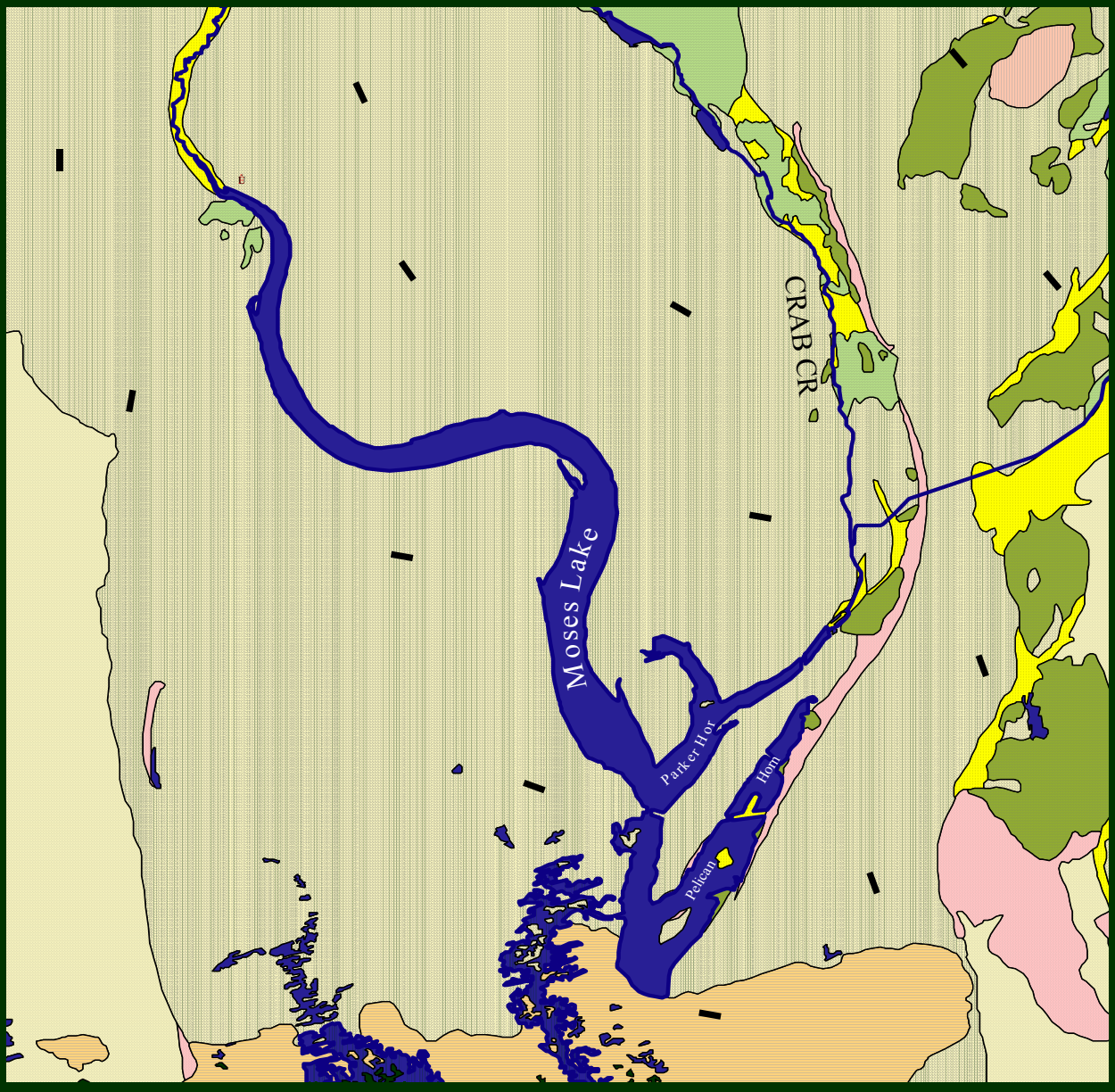
Study Purpose

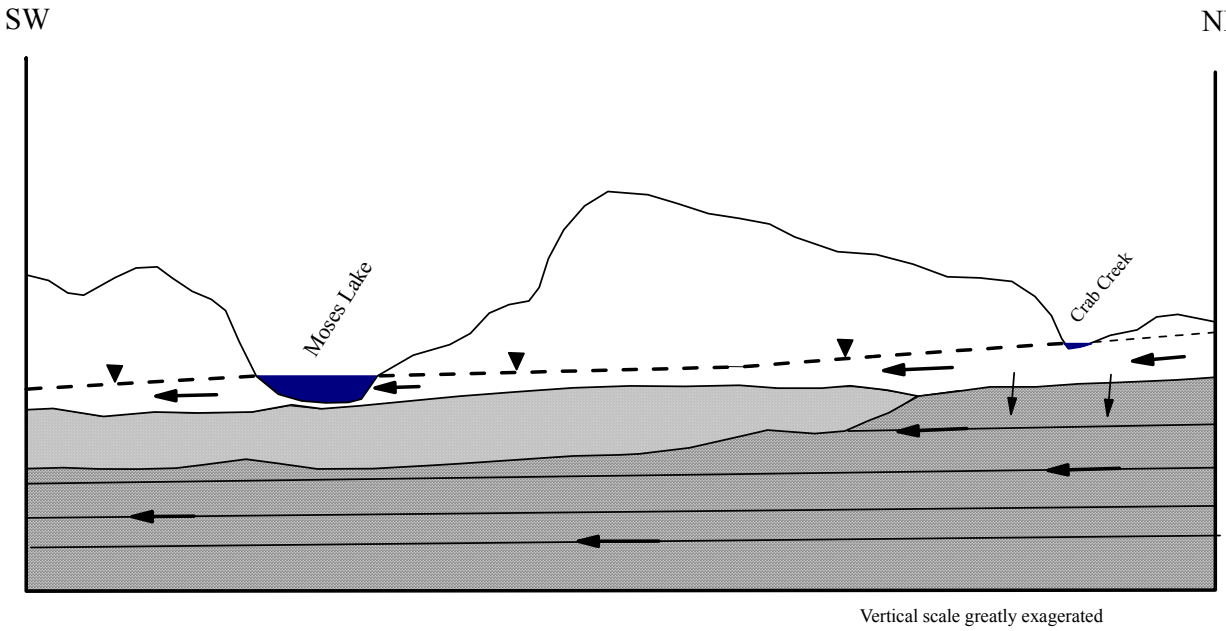
- Groundwater study in support of a Total Maximum Daily Load (TMDL) for phosphorus
- Target in-lake TP criteria established at 0.050 mg/L as P
- Examine the role of direct groundwater discharge in the lake's overall nutrient budget
- If possible, identify the sources of any nutrients observed



Moses Lake Study Area
and
Land Use Map



Moses Lake Surficial Geology and General Groundwater Flow Directions



Explanation

Overburden

Pliestocene Catastrophic Flood Deposits -
largely rounded, basaltic, fluvial gravel deposits, ranging from boulders to fine sand

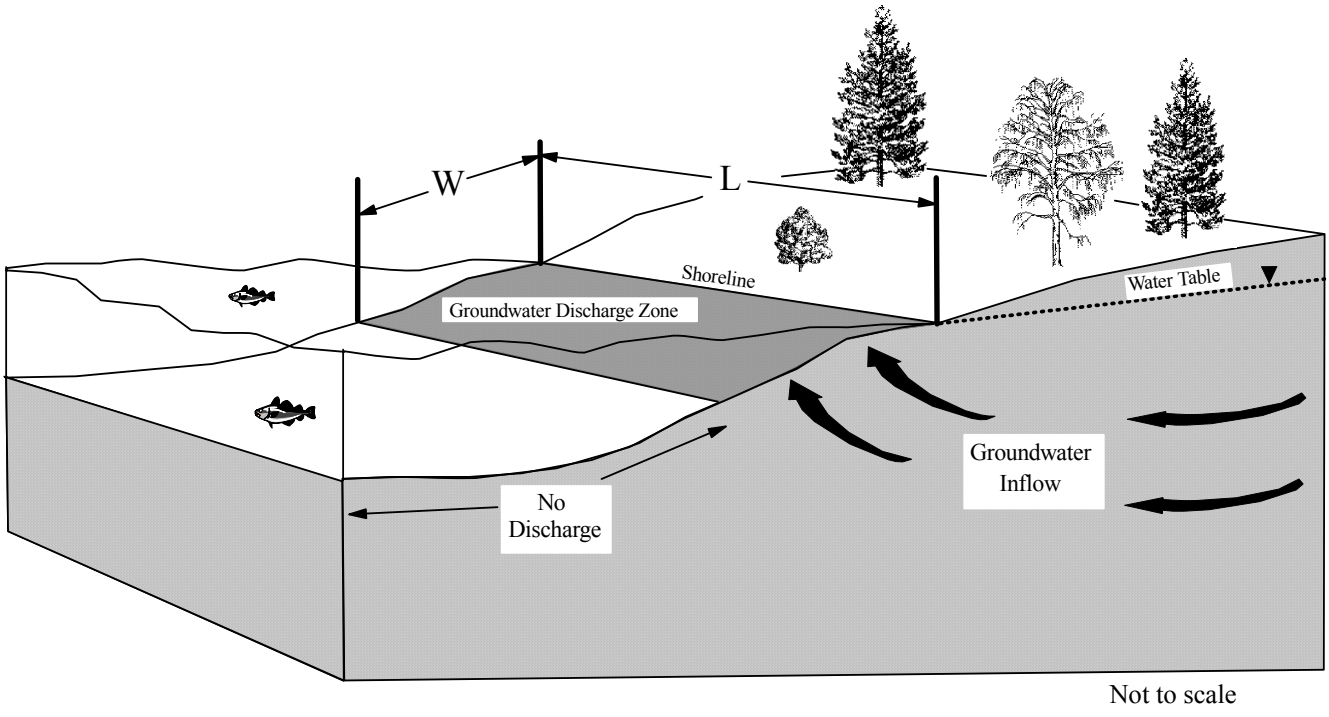
Late Miocene - Pliocene Ringold Formation -
largely interbedded lacustrine clay, tuffaceous sand and silt, caliche layers

Miocene Columbia River Basalt (CRBG) - Wanapum Formation -
fractured to massive basalts

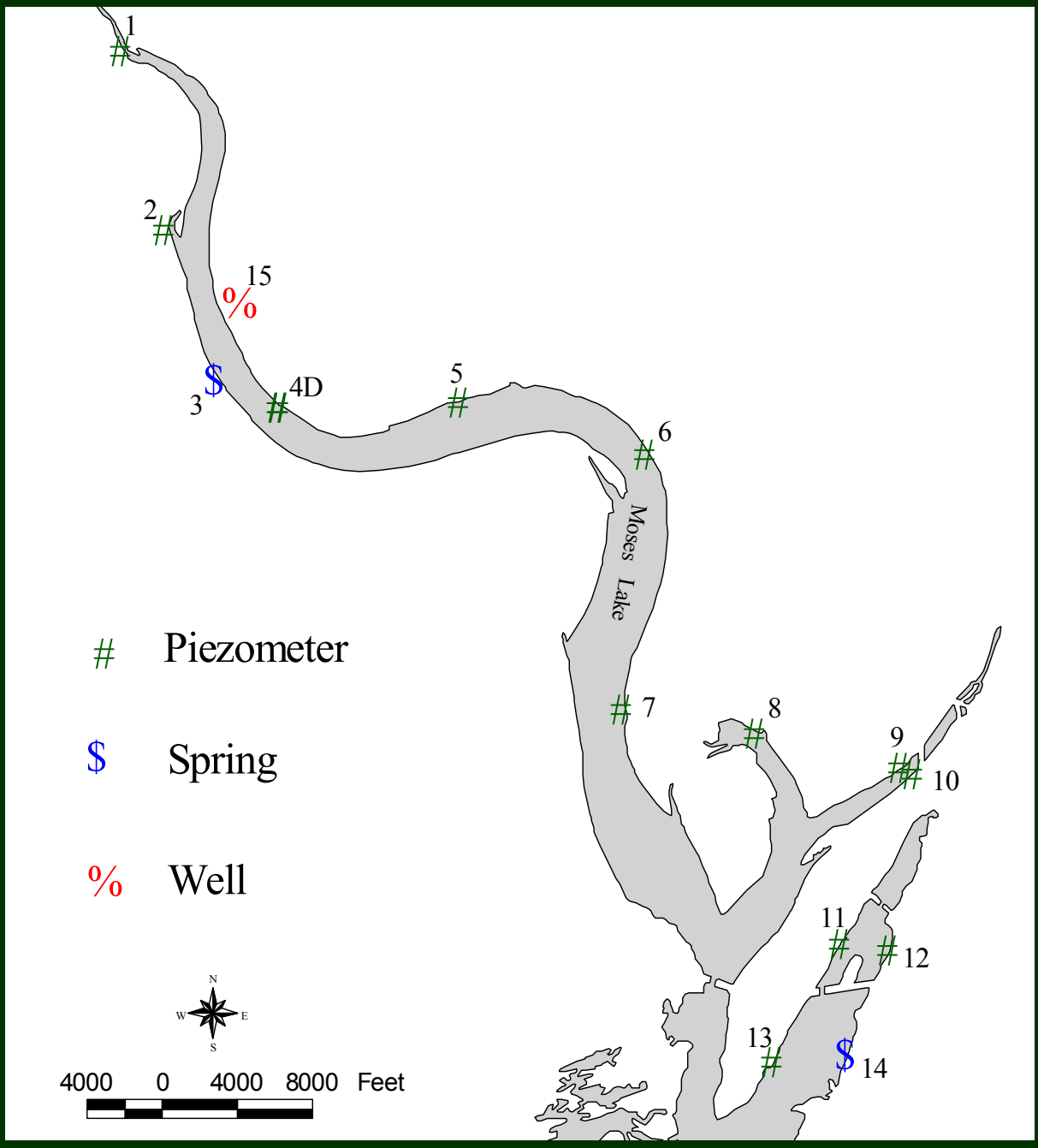
Water Table

General Groundwater Flow Direction

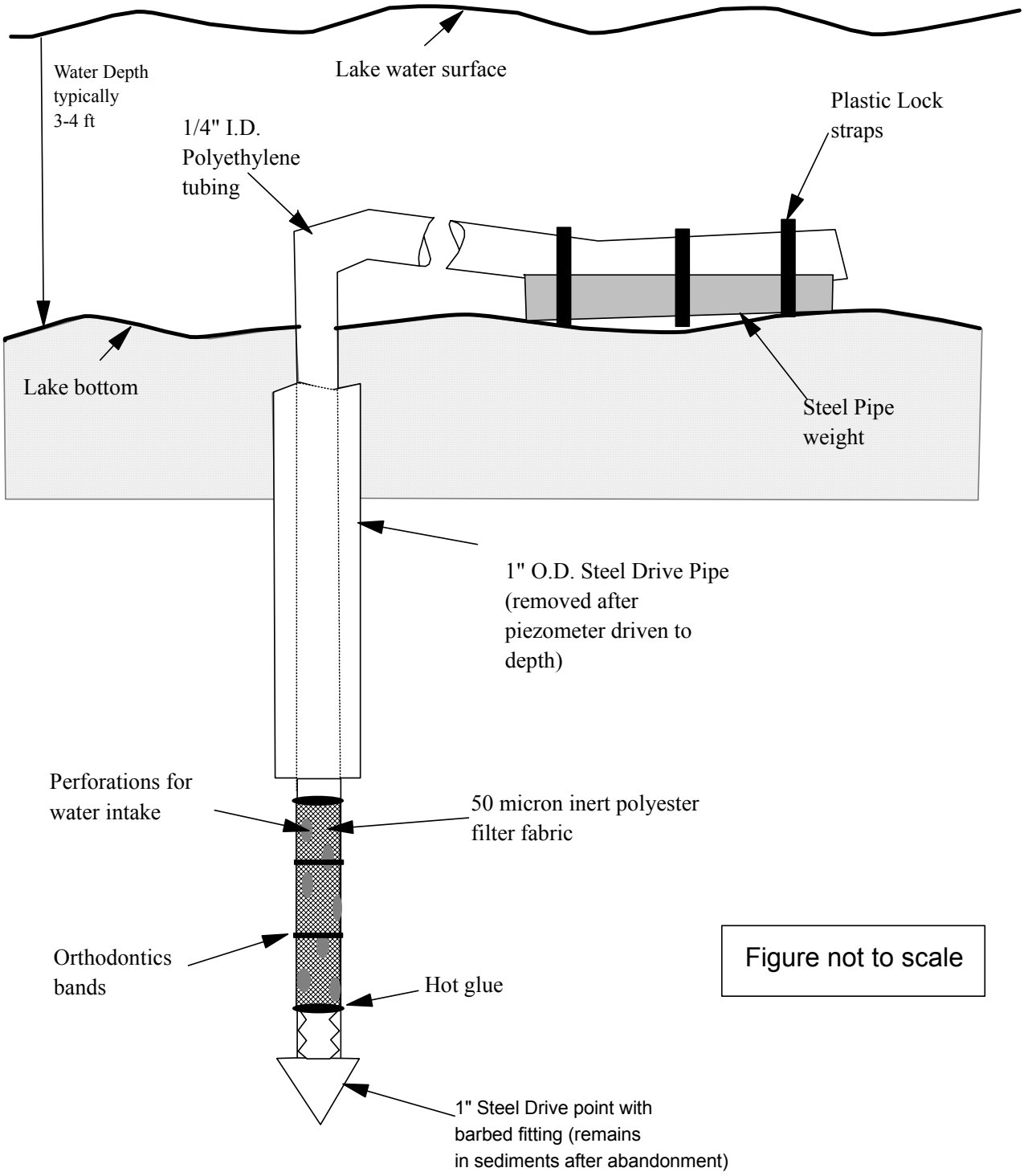
Moses Lake General Stratigraphy and Conceptual Cross-Section of Groundwater Flow



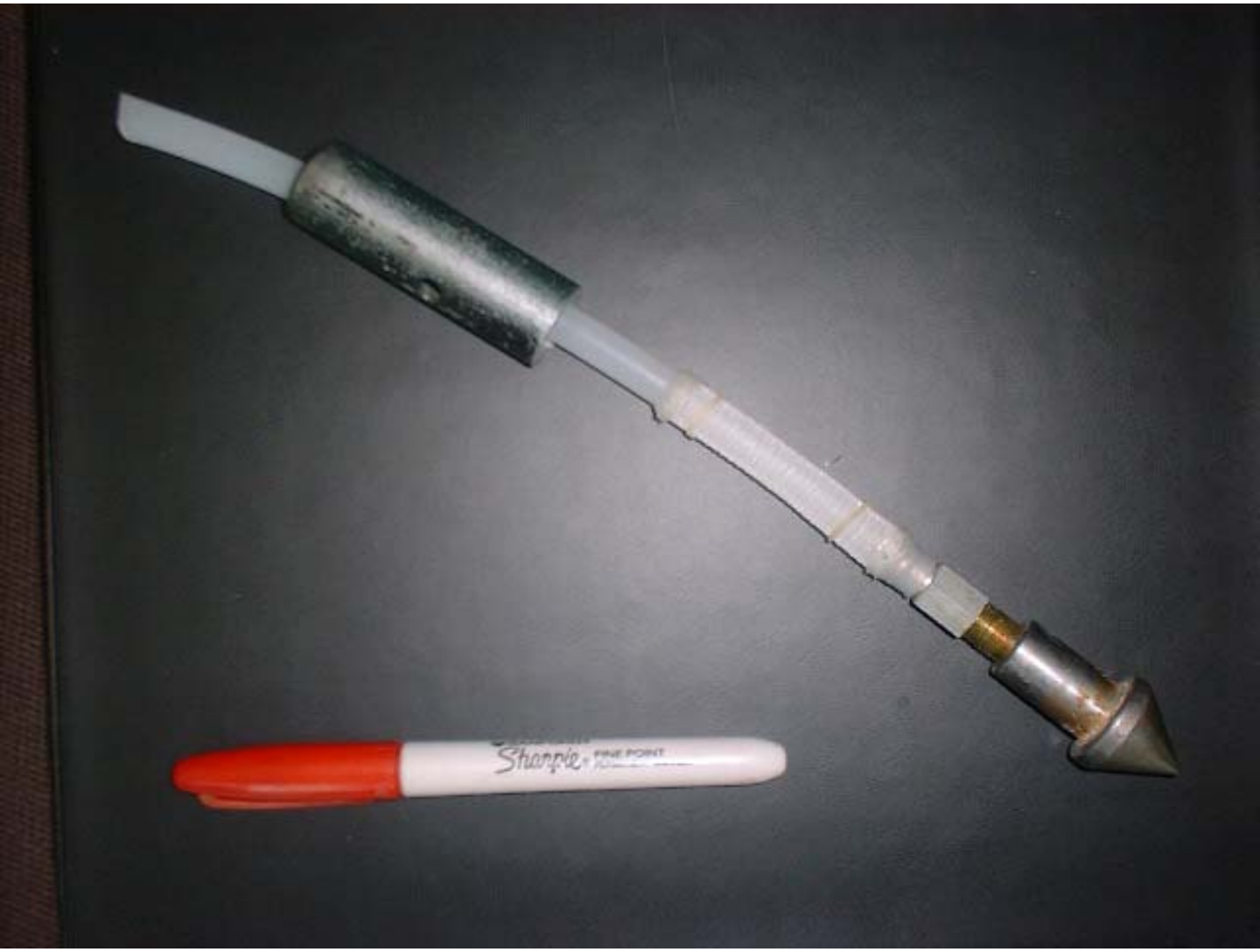
Conceptual Diagram of Groundwater Discharge and Subsurface Solute Transport to Moses Lake

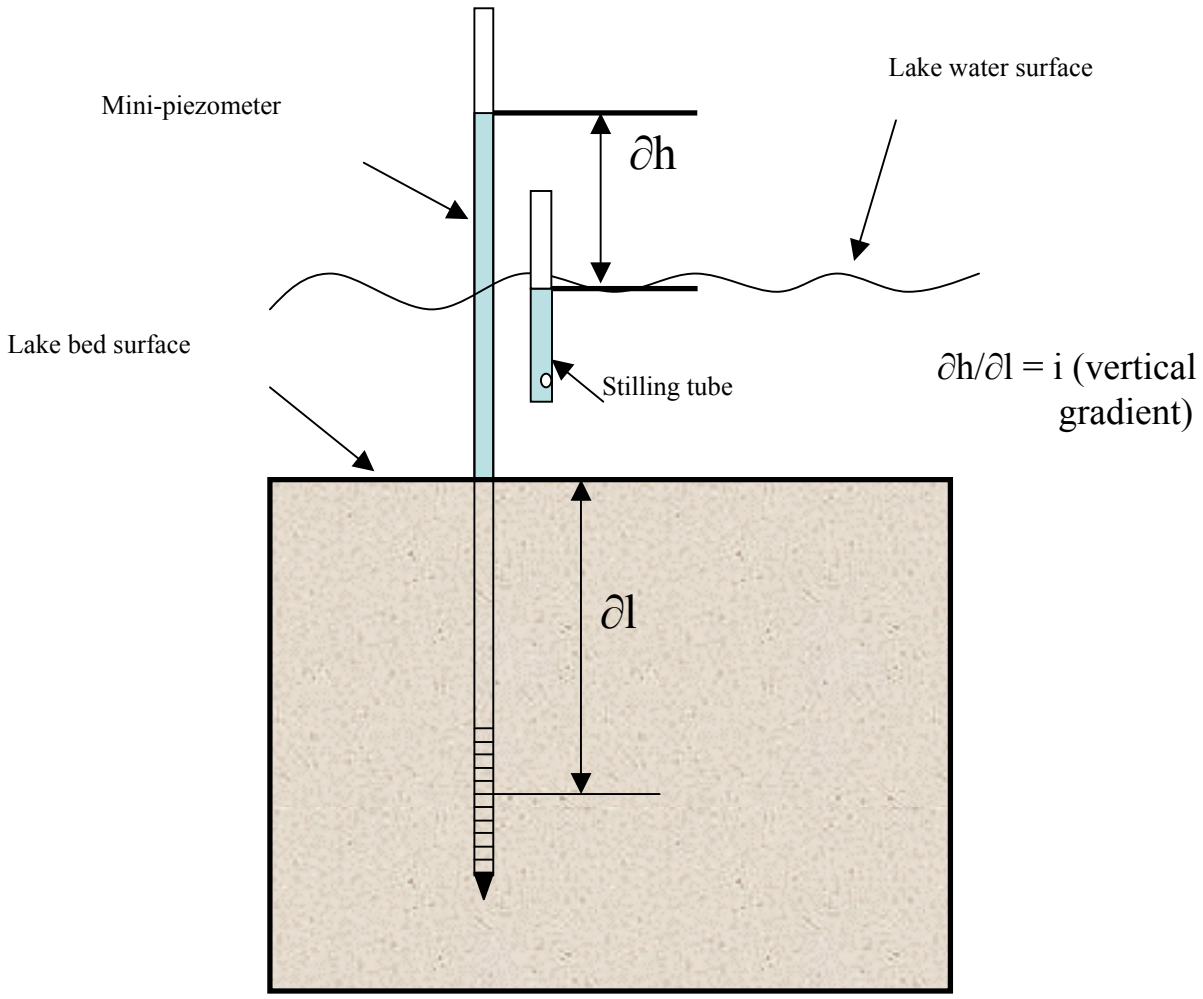


Study Sampling Locations

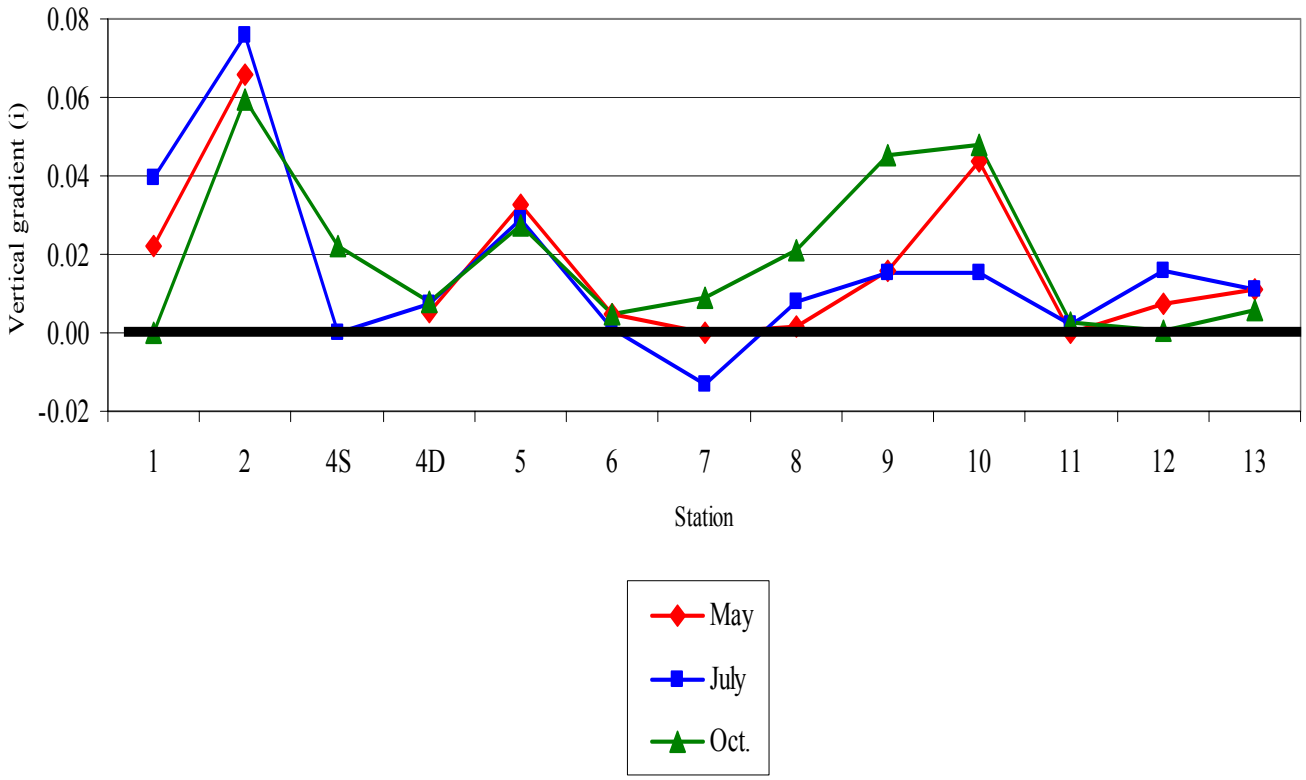


Construction Diagram for Lake-bed Piezometers

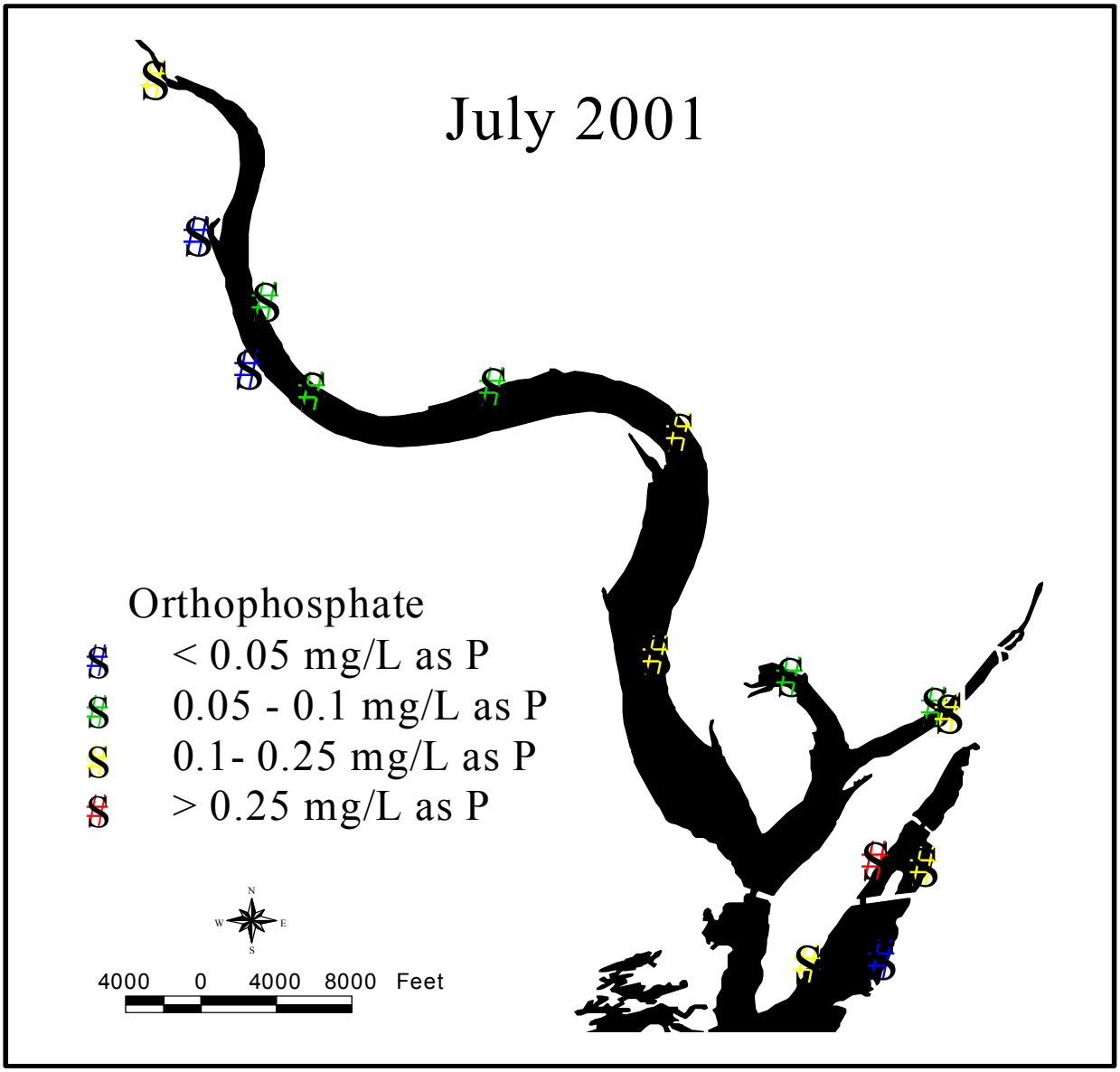

Sharpie

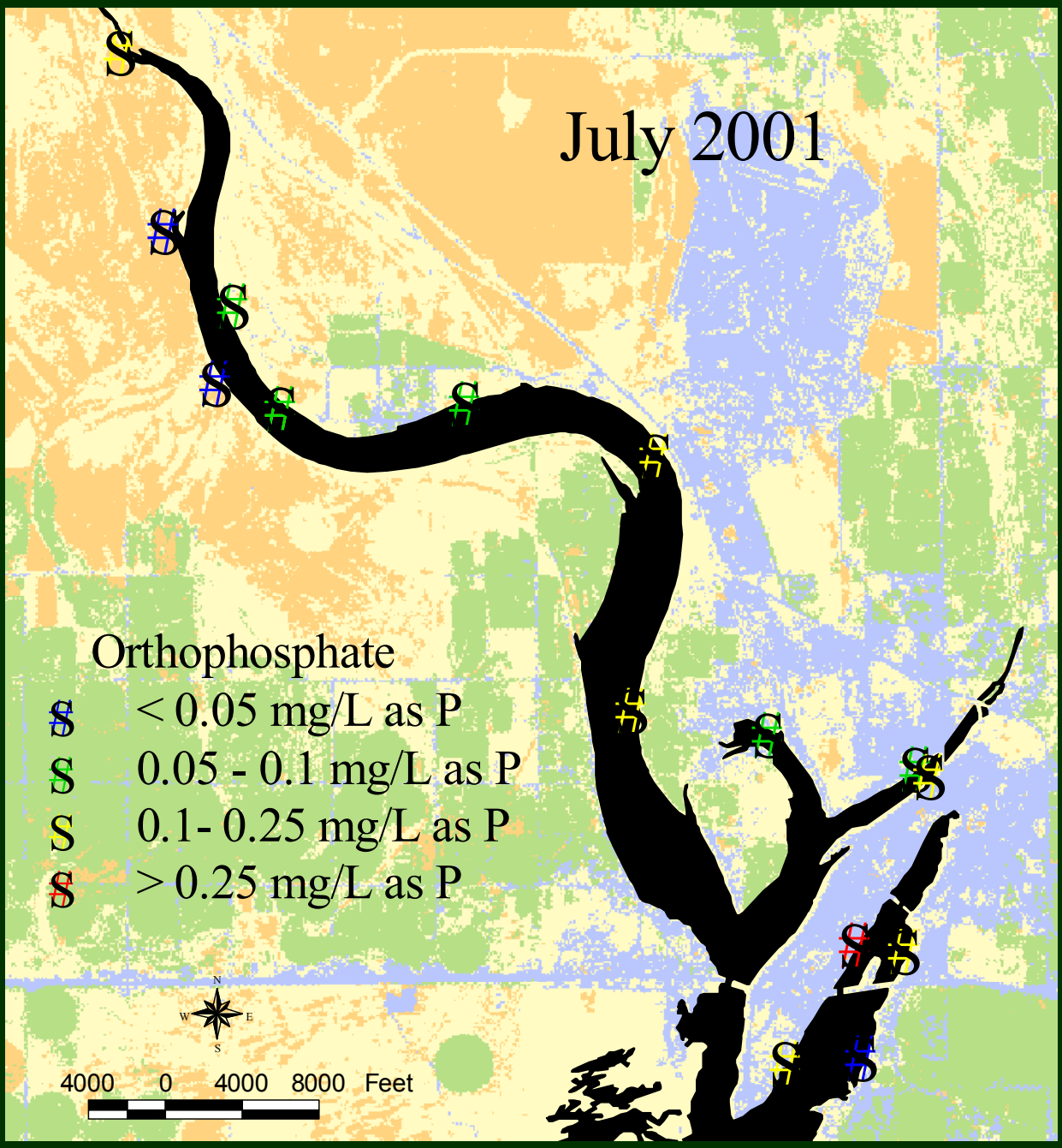


Measurement Method to Estimate Vertical Hydraulic Gradient at Study Piezometers

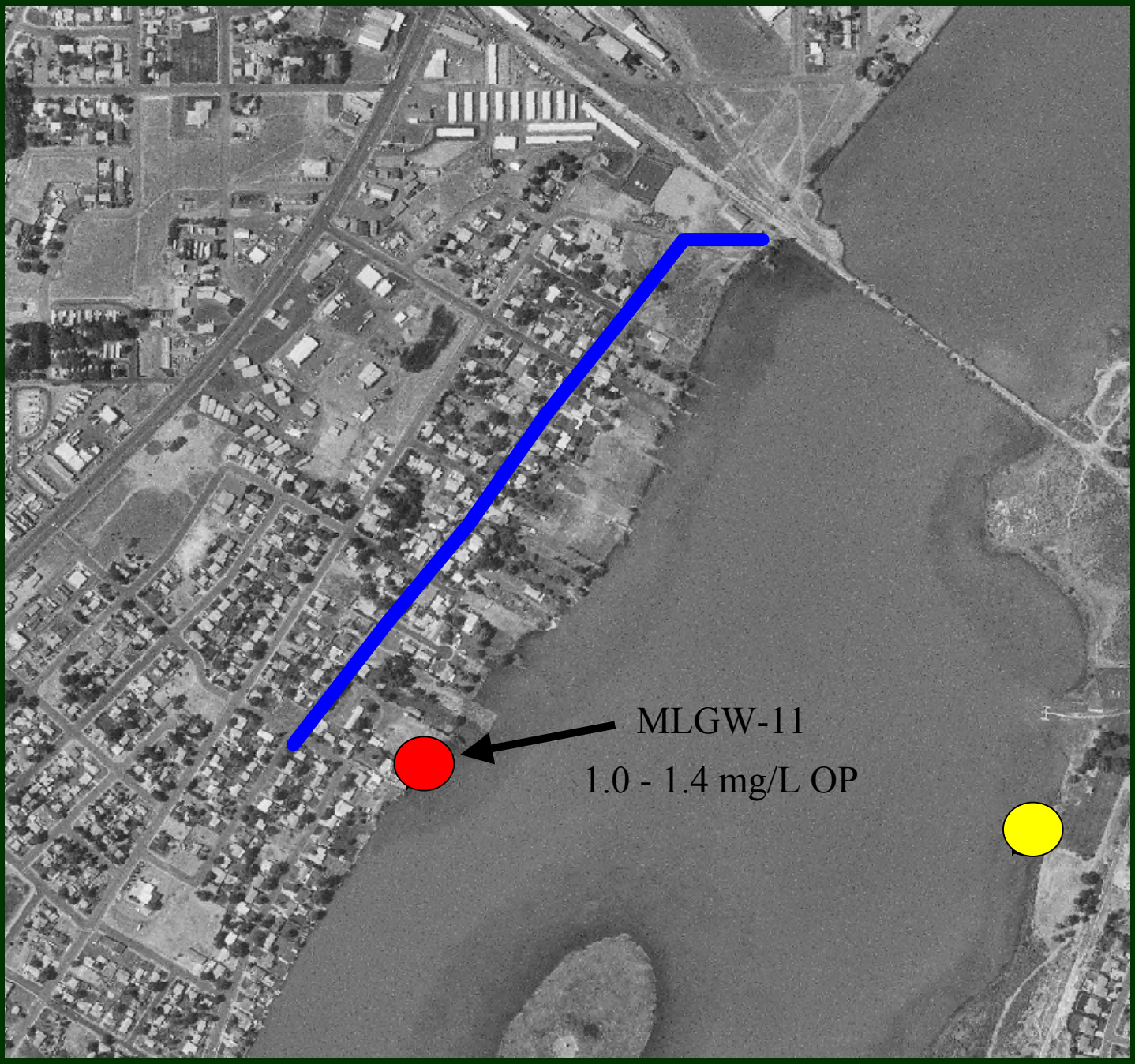


Estimated Vertical Hydraulic Gradient
at Study Piezometers


July 2001
Orthophosphate
< 0.05 mg/L as P
0.05 - 0.1 mg/L as P
0.1- 0.25 mg/L as P
> 0.25 mg/L as P
N
W
E
S
4000 0 4000 8000 Feet



Groundwater OP Concentration vs. Landuse



Moses Lake Sewer Main Relining/Replacement Project - Summer/Fall 2001

Summary of Findings

- Evidence indicates that the "background" condition for orthophosphate in area groundwater is normally <0.05 mg/L

- 75% of the stations measured had groundwater OP >0.05 mg/L

Findings (cont.)

- Coarse study area sediments have a limited natural ability to attenuate phosphorus transport

- Phosphorus concentrations in discharging groundwater are statistically related to the degree of urban development

Findings (cont.)

- Primary sources of phosphorus in area groundwater are probably a combination of:
  - leachate from drain fields
  - leakage from municipal sewer systems
  - discharge/infiltration of partially treated wastewater

- Redox conditions appear to be a primary control on phosphorus mobility in near-shore groundwater

Findings (cont.)

- Data indicate that the reducing conditions that favor subsurface phosphorus mobility/transport are also the result of wastewater releases to the aquifer

- Loading of P by direct groundwater discharge ~25% of the total annual load to the lake